Small Business Innovation Research/Small Business Tech Transfer

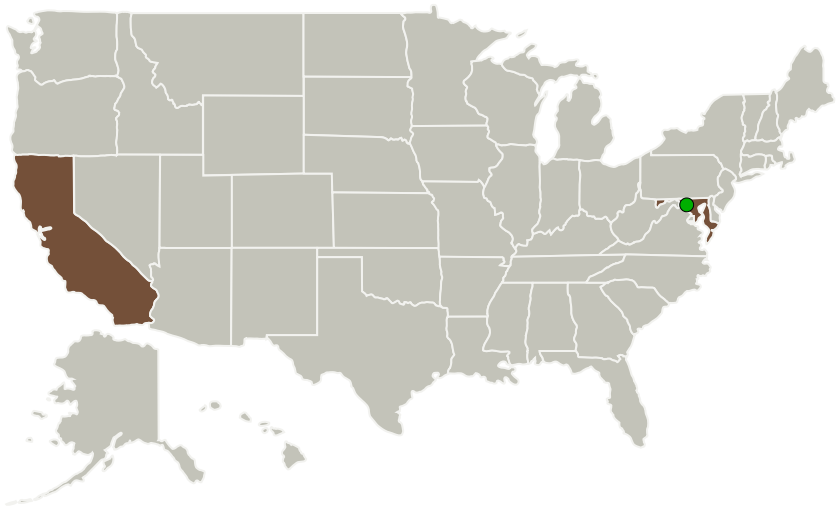
Spacecraft Rendezvous Guidance in Cluttered Dynamical Environments via Extreme Learning Machines, Phase I

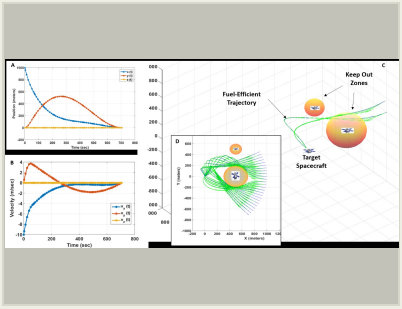
Completed Technology Project (2017 - 2017)

Project Introduction

DeepAnalytX, Inc. proposes to investigate a new approach to perform real-time, closed-loop optimal and robust rendezvous guidance in space environments comprising a potentially large number of spacecraft. More specifically, we propose to research and develop an advanced guidance system that is able to learn and track a fuel-efficient, collision-avoidance velocity vector field thus enabling safe, robust and effective relative motion guidance for autonomous rendezvous in space dynamical environments cluttered with cooperative and non-cooperative resident space objects. The guidance approach implements the next generation of Artificial Potential Functions Guidance (APFG) using an innovative combination of optimal control methods and Extreme Learning Machines (ELMs). Phase I of this proposal seeks to develop and demonstrate software for autonomous rendezvous guidance using a combination of optimal control theory and new machine learning approaches. The key critical innovation is to use ELM algorithms that enable a dramatic training speed-up of many order of magnitude. Phase I development will directly support NASA mission needs for autonomous guidance algorithms in relative motion that execute in real-time autonomous collision avoidance in a fuel efficient fashion with the goal of reducing operational risks (i.e.. increase safety) and operational costs.

Primary U.S. Work Locations and Key Partners





Spacecraft Rendezvous Guidance in Cluttered Dynamical Environments via Extreme Learning Machines, Phase I Briefing Chart Image

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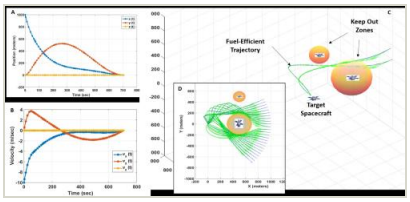
Organizations Performing Work	Role	Type	Location
DeepAnalytX	Lead Organization	Industry	Tucson, Arizona
Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations	
California	Maryland

Images



Briefing Chart Image
Spacecraft Rendezvous Guidance in Cluttered Dynamical Environments via Extreme Learning Machines, Phase I Briefing Chart Image *(https://techport.nasa.gov/image/133663)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
DeepAnalytX

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

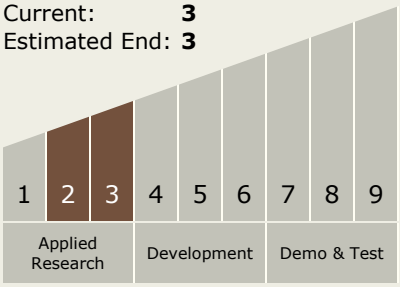
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Brian Gaudet

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



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Technology Areas

Primary:

- TX17 Guidance, Navigation, and Control (GN&C)
  - TX17.1 Guidance and Targeting Algorithms
    - TX17.1.1 Guidance Algorithms

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System